

MICHIGAN ENVIRONMENTAL SCIENCE BOARD

AIR PANEL MEETING SUMMARY TUESDAY, JANUARY 21, 1997 PARK INN INTERNATIONAL HOWELL, MICHIGAN

PANEL MEMBERS PRESENT

Dr. Lawrence Fischer, Chair
Dr. Raymond Demers
Dr. George Wolff
Dr. Ralph Kummeler
Dr. Jack Harkema
Mr. Keith Harrison, Executive Director

DMB/EAD SUPPORT STAFF PRESENT

Mr. Jesse Harrold, Environmental Officer
Ms. Patricia Hiner, Secretary

I. CALL TO ORDER

Dr. Lawrence Fischer, Chair, called the meeting of Air Panel to order at 9:00 a.m. Dr. Fischer introduced the members of the Panel. He then read the charges given to the Michigan Environmental Science Board (MESB) by Governor John Engler (see Attachment 1).

Dr. George Wolff indicated that the report should be completed well before the U.S. Environmental Protection Agency's (USEPA) June 28, 1997 court ordered deadline for a final decision on the final rules (deadlines have since been extended to July 19, 1997). He suggested that the Panel's report should be finished on or before May 1, 1997.

A brief discussion ensued regarding the possibility of presenting the report in two segments with the first being a letter that could be issued prior to the mid-February deadline for comments and the second portion being a complete report in late spring. Mr. Keith Harrison indicated that since this was not exactly what the Governor's charge was to the MESB, he would first need to first check with the Governor's office.

II. EXECUTIVE DIRECTOR'S REPORT

Mr. Harrison indicated that Dr. Bart Ostro had been scheduled to make a presentation to the Panel but had to cancel his appearance. Other individuals who had been contacted but were unable to come included, Drs. Arden Pope,

Douglas Dockery, John Evans, Fred Lipfert and Joel Schwartz. Mr. Harrison noted that copies of papers from all of the named individuals have been sent to the Panel members.

III. PRESENTATIONS

Dr. George Wolff, US Environmental Protection Agency's (USEPA) Clean Air Scientific Advisory Committee (CASAC) Chair and Principal Scientist with General Motors Corporation Environmental and Energy Staff, presented an overview of the legislative foundation which created the process by which particulate matter (PM) and ozone standards were generated, and the health effects of PM and ozone as considered by CASAC. A summary of his presentation may be found in Attachment 2.

Dr. Fischer asked if the CASAC's comments had been made available to the public and if the comments were considered in the final draft of the proposed rules. Dr. Wolff answered that the comments were available to the public and that they did have some impact on the final proposed rules.

Dr. Harkema inquired if a consistency in percent content could be correlated between PM₁₀ and PM_{2.5}, and if there was any key factor that could be derived to clarify these confounders. Dr. Wolff replied that the percent content is highly variable by location but generally 50 percent to 65 percent of PM₁₀ is PM_{2.5}. In terms of the confounders, there does not appear to be one single controlling factor.

Mr. Harrison asked how much PM_{2.5} data exists for Michigan. Dr. Wolff indicated that about four years of data were collected in Wayne county in the late 1980's at a number of sites. He cautioned against extensive use of these data since PM has been dropping at a rate of about three percent per year in across the United States.

Dr. Demers inquired if higher PM_{2.5} could be expected in an industrial area. Dr. Wolff replied that all PM would be expected to go up in an industrial area.

Dr. Fischer asked if rain removed PM_{2.5} from the air. Dr. Wolff answered that rain is the primary means of PM_{2.5} atmospheric removal but it is not very effective. The aerial life expectancy of PM_{2.5} is about a week.

Dr. Harkema asked if the cost effectiveness of the new standards were evaluated. Dr. Wolff stated that a figure of \$4.8 million value was placed on a life but the persons most effected by PM are the terminally ill, so such a figure may not be reasonable. It is a very difficult issue.

Dr. Demers asked if ozone and PM levels had anything to do with the increasing rate of asthma. Dr. Wolff answered, no, since the levels of PM and ozone have both been decreasing for the past two decades.

Dr. Fischer questioned whether PM_{2.5} or the accompanying chemicals in the production of the PM_{2.5} was the real irritant. Dr. Wolff indicated that that was not known.

Deborah Shprentz, Natural Resources Defense Council (NRDC), presented a discussion on the background, research and findings of the NRDC report entitled, *Breathtaking: Premature Mortality Due to Particulate Air Pollution in 239 American Cities*. A summary of her presentation may be found in Attachment 3.

Drs. Fischer and Demers asked about the availability of additional information regarding the statistical methodology used in the Harvard Six City study. Ms. Shprentz said it was available in the USEPA literature reviews.

Dr. Harkema asked whether monitoring was done for each city in the same way in the Harvard Six City study. Ms. Shprentz answered that in the Harvard Six City study centrally located monitors were used for each city. States must use standard monitoring equipment and protocols and meet other standard federal criteria for monitoring.

Dr. Fischer asked why the NRDC had not recommended research identifying possible toxic particles or substances in the particulates. Ms. Shprentz answered that it should be done, and that some researchers are working on it, but the NRDC chose to concentrate on control instead.

Dr. Kummier asked what advice Ms. Shprentz would give local officials about what to control, given that particles have different compositions and no one yet knows which are toxic and may be causing the problems. She replied that the NRDC believes that the commonality among the dozens of epidemiological studies is that an association is observed with particles as a whole, regardless of the different particle mix in any area. Their recommendation is that particles as a whole be reduced, and in order to get that in a local area, information will be needed on the mix of particles, so the appropriate sources can be reduced. Particulate matter may be a surrogate for a particular toxic agent, but the effects are observed no matter what particular combination of pollution exists in a particular area.

Dr. Demers asked whether Ms. Shprentz thought that the health effects would be the same if transport mechanisms were available for getting toxins into the lungs in the absence of particulate matter. Ms. Shprentz replied that while different air pollutants may be associated with different health end points, there has been a strong case made for particulates themselves. Some work has been done on

different mixes of pollutants and should continue, but the case against particulates themselves remains strong.

Dr. Harkema asked whether it was really clear that particulate matter concentrations were going down because of tighter regulations or whether other factors, such as temporary weather conditions were causing the decline. Ms. Shprentz stated that she thought so, and that the standards now in effect will continue to result in improvements, although economic growth may be a drag on the rate of that improvement. But even with new control programs scheduled to be phased in over the next several years, the process of improvement will be very lengthy by the time monitoring is done and control strategies are implemented, causing large numbers of premature deaths.

Dr. Wolff commented that the CASAC recently looked at trends in all categories of both attainment and non-attainment zones and found the trends essentially identical, leading to the conclusion that it is national, not local, controls that are driving down the PM. He thinks the improvements will continue. The Harvard study did not look at the long term trend.

Dr. Demers noted a discrepancy in smoking rates between the Harvard Six City study and the ACS study that could not be accounted for by the general decline in smoking. Ms. Shprentz indicated that the Harvard researchers chose a random sample, but the ACS sample was voluntary, so the populations are not strictly comparable. Dr. Demers then asked where the figures of a one or two year shortened average life span came from. Ms. Shprentz stated that they were part of the press releases that accompanied the Harvard Six City and ACS studies and were not part of the NRDC's findings.

Dr. Wolff indicated that there is a paper by Mort Lippmann and Thurston that makes that estimate. He explained that the authors saw that the mortality rate in the cross-sectional studies was three times higher than that predicted from the short-term studies and attributed the difference to chronic illness and came up with the one to two year estimate. Ms. Shprentz indicated that the World Health Organization does have a methodology for making estimates and that some have been done in Europe. Dr. Demers indicated that these should be reviewed by the Panel.

Dr. Demers asked about the existence of negative studies in order that the Panel could compare and evaluate the quality of the research. Ms. Shprentz stated that she was not aware of those specifically, although there are many that find different, weaker, or stronger associations. Dr. Wolff said that not many were funded prior to the CASAC review, but that more will be forthcoming. There may be something available from the National Institute of Statistical Sciences (NISS). He also said that the Health Effects Institute was able to get the Harvard data and found that the results could be reproduced if the original steps and assumptions were followed exactly, but any other methods produced different

results. For instance, if the effects of other pollutants or the effects of seasons were considered, the same conclusions would not result.

Dr. Fischer asked whether the cardiopulmonary mortality data came from death certificates and what diseases were included in that category. Dr. Demers listed the particular diseases and noted that more are cardiac than pulmonary. Part of the problem is that pulmonary disease is harder to code than cardiac. Consequently, it gets under-represented on death certificates. Pulmonary disease is probably of the most interest here.

Dr. Fischer expressed concerned that no direct causality had been established. Ms. Shprentz said that Anthony Seitan had done some work on what toxicological mechanisms may be at work when particles are inhaled. This issue is not any different than the initial work on the relationship between smoking and mortality, where the causal mechanisms were not established until decades after the epidemiological work.

Dr. Harkema asked Dr. Wolff if the current research need was in epidemiology or toxicology. Dr. Wolff indicated that it was needed in both. He stated that the CASAC was disappointed with USEPA's research proposals since they assumed as a beginning point that a PM-mortality relationship existed; a point which has yet to be documented. The CASAC is recommending to USEPA that the issue be explored further.

IV. PANEL DISCUSSION

Dr. Fischer indicated that he envisioned that the report would be written in the usual manner, with meetings being held for information and discussion, then the individual Panel members writing sections of the report based on their own expertise. He stated that he would like to have the report submitted to the Governor no later than May 1, 1997 - if not sooner. Dr. Demers suggested that the Panel arrange to speak to scientists who have been actively involved in this issue on either side, so they could focus on specific issues. He mentioned John Samet, a member of the CASAC. Given the difficulties encountered with getting the experts to Panel meetings, Mr. Harrison encouraged all Panel members to contact directly and solicit comments from the various identified researchers.

V. PUBLIC COMMENT

Dr. Larry Holcomb stated that people spend about 85 percent of their time indoors, so exposure time indoors and outdoors should be considered. The generation of ozone indoors and outdoors is somewhat different and from different sources. He also mentioned that ozone is altered as it passes through air treatment systems, usually being diminished. Particulates are also affected in a similar manner as ozone as they pass through air treatment equipment. Dr.

Holcomb indicated that he would get several papers regarding indoor air to the Panel.

He also expressed a desire for the Panel, as it looks at all the various studies, to evaluate the merits of the investigations including how they were designed and how the data were interpreted. He indicated that there tends to be a club of researchers who have worked on and published material on the air issues together. In many instances, they often have served as peer-reviewers of each others' publications. Sometimes this familiarity can get in the way of critical evaluations and sound interpretations of study results.

VI. NEXT MEETING DATE

Mr. Harrison indicated that his office would contact the Panel members to schedule the next meeting.

VII. ADJOURNMENT

The meeting was adjourned at 3:10 p.m.

Respectfully submitted,
Keith G. Harrison, M.A., R.S., Cert. Ecol.
Executive Director
Michigan Environmental Science Board

Attachment 1. November 21, 1996 and December 4, 1996 Letters to the Michigan Environmental Science Board from Governor John Engler.

Dr. Lawrence Fischer, Chair
Michigan Environmental Science Board
P.O. Box 30026
Lansing, Michigan 48909

November 21, 1996

Dear Dr. Fischer:

The U.S. Environmental Protection Agency (EPA) is currently reviewing the National Ambient Air Quality Standards for particles and ozone. The EPA is under court order to complete its review for particles by November 29, 1996. In June 1996, the EPA Clean Air Scientific Advisory Committee (CASAC) recommended that a standard for fine particulate matter (PM_{2.5} - particles with diameters less than or equal to 2.5 mm) be established, but there was no consensus on the level, averaging time or form of the standard. In May 1996, the Natural Resources Defense Council (NRDC) released a report based on a 1995 data base compiled by the American Cancer Society and analyzed by Brigham Young and Harvard Universities. This report purports that a substantial number of people die earlier than would otherwise be expected because of their exposure to fine particulate matter. The NRDC report recommends that the EPA establish a PM_{2.5} standard of 10 µg/M₂ on an annual average basis and stringent new limits on 24-hour concentrations.

Given the potential significance of a new PM_{2.5} standard to the well-being of Michigan's citizens and economy, I am requesting that the Michigan Environmental Science Board (MESB) thoroughly evaluate the air quality and human health scientific assumptions, interpretations and conclusions contained in the NRDC report. The MESB evaluation should determine the following:

1. Identify and evaluate the validity of the key air quality and human health assumptions. This would necessarily entail a thorough review of previously published reports by Brigham Young and Harvard Universities, the EPA and the CASAC.
2. Identify and evaluate the appropriateness of the methodology used to develop NRDC estimates of mortality and determine if there was sufficient evidence to attribute causality.

I would encourage the MESB to seek assistance in this assignment from appropriate state and federal agencies, your peers in the academic and scientific communities and the Natural Resources Commission's Air Quality Relative Risk Task Force. I would appreciate receiving your report as soon as possible. Thank you for your continuing service to the State of Michigan.

Sincerely,
John Engler
Governor

cc: James K. Haveman, Director, MDCH
Russel J. Harding, Director, MDEQ
Keith G. Harrison, Executive Director, MESB
George Wolff, Chair, AQRRTF

Dr. Lawrence Fischer, Chair
Michigan Environmental Science Board
P.O. Box 30026
Lansing, Michigan 48909

December 4, 1996

Dear Dr. Fischer:

As you know, the U.S. Environmental Protection Agency (EPA) has now released its proposed revisions to the National Ambient Air Quality Standards. On November 21, I asked you to evaluate a Natural Resources Defense Council report concerning the human health impact of ground-level ozone and particulate matter. As part of that assignment, I also asked you to conduct a thorough review of previously published studies on this issue. EPA has based their proposed revisions to the particulate matter and ozone standard on these studies, in one instance stating that the revised standards will "reduce premature deaths by 40,000 per year." I, too, am concerned about any potential human health effects of air quality. Thus, I would reiterate and expand my request to the Michigan Environmental Science Board by asking that you thoroughly review the human health assumptions, interpretations and conclusions of the studies that are the basis of EPA's proposed rules.

Given the short review and public comment period on EPA's proposed rules, I would appreciate receiving your report as soon as possible. Thank you, once again, for your continuing service to the State of Michigan.

Sincerely,
John Engler
Governor

cc: James K. Haveman, Director, MDCH
Russel J. Harding, Director, MDEQ
Keith G. Harrison, Executive Director, MESB
George Wolff, Chair, AQRRTF

Attachment 2. Presentation Summary of Dr. George Wolff, Clean Air Scientific Advisory Committee, to the Michigan Environmental Science Board Air Panel.

Dr. George Wolff, Clean Air Scientific Advisor Committee (CASAC) chair, began his presentation with an overview of U.S. Environmental Protection Agency's (USEPA) review process. Under the 1967 Clean Air Act, the Health, Education and Welfare Department was directed to prepare criteria documents summarizing the science on ubiquitous air pollutants. From these findings the USEPA set the 1970 National Ambient Air Quality Standards (NAAQS). In 1971 the findings were finalized and the criteria contained acceptable levels for sulfur dioxide, carbon monoxide, nitrogen dioxide, ozone and particulate matter (PM).

The normal steps in the review process included the following: the USEPA produces a revised criteria document which contains summarized relevant science; CASAC reviews the documentation from the USEPA; CASAC suggests revisions; USEPA resubmits the revised document; CASAC reviews the document again and so on until CASAC produces a closure document. This closure document may not agree with USEPA's position entirely but the varying positions and parameter values are documented and recommendations are made. Even though the CASAC recommendations were rejected in the most recent review process, CASAC can still make comments during the comment period which follows. CASAC was originally composed of seven members but was enlarged to 21 members when more expertise was needed.

The original standard was set on total suspended particulate (TSP) with a particle diameter less than about 40 microns (PM_{40}) at $260 \mu\text{g}/\text{M}_2$ for a 24 hour period and $75 \mu\text{g}/\text{M}_2$ average annually. After five years CASAC was to review these standards and report their findings to the USEPA Administrator. Reviews were conducted as new scientific information became available, the last being in 1987. This review showed that PM greater than 10 microns was not inhaled and the standard for PM_{10} was set at $150 \mu\text{g}/\text{M}_2$ for 24 hours and an annual averages $50 \mu\text{g}/\text{M}_2$. It was later realized that mouth breathing people took in PM_{10} particles but nose breathers only inhaled particles less than 2.5 microns. The last review was ordered by the court as a result of a legal suit by the Lung Association.

The biological response to PM is particularly evident at high concentrations. Two types of PM epidemiology mortality drove this review. The first linked daily mortality (acute studies) and cross sectional studies (annual mortality and geographic regions). The second type of study was the basis of the Natural Resources Defense Council (NRDC) report. Generalizing, this study showed an excess mortality rate of about four percent per $50 \mu\text{g}/\text{M}_2$ increase in particulates. These studies were done using PM_{10} data and a linear increase was assumed without a threshold level.

The standards are supposed to be set by calculating the no effect level of an agent and adding a small safety margin, about 20 percent. PM between 2.5 and 10 microns is essentially wind blown dust from grinding and sanding operations and the result of vehicles moving down the road (Buffalo effect PM). The PM_{2.5} and less are roughly generated in equal parts by atmospheric chemical reactions and combustion.

The original USEPA recommendations for PM_{2.5} were from 25 µg/M₂ to less than 85 µg/M₂ for the 24 hour standard and from 15 µg/M₂ to 30 µg/M₂ for an annual average standard. The final USEPA staff recommendations ranged from 18 µg/M₂ to less than 65 µg/M₂ for the 24 hour standard and from 12.5 µg/M₂ to 20 µg/M₂ for the annual average standard. The recommended target was 50 µg/M₂ for the 24 hour standard and 15 µg/M₂ for the annual standard. These proposed standards were based on epidemiological health effects.

The USEPA recommendation is to retain the present PM₁₀ standards and create new 24 hour and annual PM_{2.5} standards. Under the new proposed PM₁₀ standards, the number of areas not in compliance would roughly quadruple. Four members of CASAC supported a level near the lower end of USEPA's proposed range. Eight members declined to select a level but lean to the upper end or higher. Seven members supported ranges or levels near, at or above USEPA's proposed range. Even members from the medical community reflected this diversity of opinion. Dr. John Samet, an epidemiologist on the Committee, indicated that USEPA should set a new PM_{2.5} standard only if USEPA has confidence that requiring an PM_{2.5} standard will indeed reduce the components of particulate responsible for their adverse effects. The data in Michigan for PM_{2.5} are so sparse that it would be very difficult to determine the impact of the new standards on the state.

After a year and many meetings, CASAC could not come to a consensus on the PM_{2.5} standard. Two of the 21 Committee members could not support a PM_{2.5} standard.

There were many issues which created the diverse positions of the 21 Committee members. Some members questioned if the PM_{2.5} at the considered levels had any effect on mortality and some ascribed the mortality counts to terminal patients who may have died a few days prematurely, possibly from PM exposure. A third of the people used in the acute studies died in the hospital, in indoor air. Some Committee members felt that the relationship of outdoor air to indoor hospital air was not taken into consideration by the USEPA. Other Committee members expressed a concern that the relationship between daily mortality and ambient temperature was overlooked. A lag time from PM exposure to mortality was recognized, but of the about 18 cities modeled, the statistical results of lag time were never matched.

When seasonal effects and individual pollutants were examined even more confusion was generated. As one example, the data used to support the toxic supremacy of PM_{2.5} over PM₁₀ was recently determined to be weak because of a recent review of the Six City Study. This review showed a plus or minus variance in the collection of coarse (greater than PM_{2.5}) and fine (lesser than PM_{2.5}) particulate matter of 35 percent. The city studies supporting the new PM standards were only valid under the assumptions made for each particular study. The mere recalculation of one study rendered the findings inconclusive. The assumptions and/or methodologies varied in all the different city studies. Seasonal variation also was not considered in any of the studies, and when applied to the studies, flawed the original findings. Some of the studies employed "British Smoke", more a measure of carbon than PM. The correlation between outdoor air PM and hospital air PM was never correlated. Many on the Committee felt that these and other various confounding factors were not adequately addressed. As the review moved along, the Committee, as a whole, became more and more skeptical of the science, methodology and assumptions used to form the USEPA's conclusions.

In terms of ozone, this has fallen into the same approval time frame as PM. In 1971 the ozone one hour standard was 0.08 parts per million (ppm). In 1977 the standard was relaxed to 0.12 ppm with one allowable exceedance per year for non-attainment. In 1993 this standard was reaffirmed. The proposed 1996 standard is between 0.07 ppm and 0.09 ppm in an eight hour sample with one to five exceedances per year for non-attainment. Since the background ozone is around 0.05 ppm, meeting 0.07 ppm would be very difficult, but at 0.09 ppm it would be much as it is now, even with three or four exceedances per year. What finally appeared in the *Federal Register* is an eight hour sample at 0.08 ppm and a formulated three exceedances per year. This is considerably more stringent than the present standard. In terms of Michigan, Southwest Michigan, Detroit and Flint would likely be in non-attainment under this standard.

A number of studies have shown that a progression of lung effects occur with a rise in ozone levels. None of the studies, however, could establish a threshold effect level which for safety the Clean Air Act mandates. The Committee requested that the USEPA conduct some risk assessments to assist in the Committee's decision. The USEPA found no statistically significant health effects for all the currently considered or present standards for ozone. For example, if New York City met the present standards and it was then lowered, asthma admissions would drop from 29,793 to 29,646; a 0.3 percent drop. This percentage decrease is statistically insignificant and ozone's contribution to case load is trivial.

Attachment 3. Presentation Summary of Ms. Deborah Shprentz, Natural Resources Defense Council and Principal Author of *Breathtaking: Premature Mortality Due to Particulate Air Pollution in 239 American Cities*, to the Michigan Environmental Science Board Air Quality Panel.

According to Ms. Shprentz, there have been several dozen studies reporting associations between health effects and particle concentrations in the air even at levels below current standards. The USEPA had estimated 70,000 premature deaths each year are associated with particulates, and the Harvard School of Public Health, 60,000. The NRDC, in its report entitled, *Breathtaking: Premature Mortality Due to Particulate Air Pollution in 239 American Cities*, was trying to focus public attention on the issue to encourage the USEPA to review current particulate standards. Because USEPA reviews and implementation can take several years to accomplish, the NRDC also sought to identify control strategies that could be implemented used by local officials before any new standards would take effect.

One of the initial studies on this issue was in Provo, Utah by Dr. Arden Pope. In that report it was indicated that children's hospital admissions for respiratory causes dropped dramatically during the 13 months a local steel mill was shut down concurrent with reductions in particulate pollution. Several subsequent Utah Valley studies reported links between particle pollution and a variety of health endpoints. Studies of other steel mill towns, like Birmingham and Philadelphia, focused on hospital admissions for respiratory and cardiac causes, health care costs and mortality. The Harvard School of Public Health initiated another study of six cities, all meeting current air quality standards, but with varying levels of pollution. It was a study designed to address criticisms of earlier epidemiological studies by statistically controlling for other health factors, and followed 8,000 adults for 16 years. The Harvard Six City study, published in the *New England Journal of Medicine* in December 1993, found that the residents of the most polluted city had a 26 percent greater risk of premature mortality than residents of the least polluted. According to the study's authors, this translated into a one to two year shortened life span, even when current air quality standards were being met. The American Cancer Society (ACS), which was also following a cohort at the time the NRDC's study was being conceived, reported a slightly lower risk than the Harvard study. The NRDC was advised to wait until that study was released, so the ACS's more conservative risk estimates could be used. In the interim, other expert panels, such as one in Britain, the Health Council of the Netherlands, and the World Health Organization, had concluded that there was a cause and effect relationship between particle pollution and a range of adverse health effects.

Ms. Shprentz presented a graph developed by the USEPA showing time series for some of the mortality studies. The data clearly suggested a linear relationship and the absence of a threshold. A number of scientists and

agencies have evaluated the literature, using a weight of evidence approach, and based on the consistency among studies and coherence with other known facts, concluded that a causal relationship has been established. Based on the literature and methodological reviews, the NRDC made certain assumptions, like linearity, and recognized some of the uncertainties involved. Questions accounted for in the NRDC report included whether the negative health association occurred with particle pollution as a whole or with some specific components of particles; whether the association is actually with current exposures or the result of cumulative exposures or prior exposures at much higher levels; and whether outdoor monitors can accurately characterize indoor exposures. Even in assuming linearity, the study only extrapolates from within the range of concentrations already studied by the ACS. The NRDC study also assumed a ceiling on pollution, so that the areas more polluted than the most polluted city in the ACS study are assumed to have only the level of that most polluted city.

For the report, the NRDC collected city specific mortality data from the National Center for Health Statistics for Metropolitan Statistical Areas (MSA). It looked at the ICD9 codes that the ACS had used, focusing on cardiopulmonary, rather than total, mortality. PM₁₀ monitoring data from USEPA NAMS and SLAMS monitoring networks, operated by state and local governments to USEPA standards, was averaged for five years. Bias for seasonality was adjusted for by using only data for years which had 75 percent completeness. A 60 percent adjustment factor was used to calculate PM_{2.5} concentrations from the PM₁₀ monitoring data. The PM_{2.5} concentration was used because the ACS only reported a risk factor for that, and not for PM₁₀. All the monitoring stations located in a MSA were averaged together.

The NRDC added a number of factors that added some conservatism to its analysis. It looked at areas that represented only 60 percent of the population. It also used the chronic study that reported a lower risk factor for a base case analysis. It focused only on cardiopulmonary, rather than total, mortality. The NRDC also did a sensitivity analysis to look at the impacts of alternative assumptions. Assuming that air quality levels were historically double contemporary levels, the risk estimate would have been half. On the other hand, had the NRDC used the higher risk ratios reported in the Harvard Six City Study, using the PM₁₀ with a ratio for total mortality, the estimate would have been double.

The report ranks the top 50 cities in terms of cardiopulmonary deaths attributable to particulate air pollution. The estimates, as well as those of the Harvard School of Public Health and the USEPA, show a large public health risk from particulate air pollution. The USEPA is proposing an annual PM_{2.5} standard of 15 µg/M₂ which the NRDC estimates could avert 20,000 premature deaths. The USEPA is also asking for comments on a standard of 20 µg/M₂, which would have minimal impact.

Many areas have reached attainment by reducing heavier particles, like wind blown dust and wood smoke. It is easier to reach the mass based standard by reducing heavy particles rather than the PM_{2.5} fine particles from industrial fossil fuel combustion sources.

The NRDC report recommends that the USEPA establish a new standard for fine particles and a tighter standard for PM₁₀; that priority be given to the control of combustion sources; and that state and local governments review new source permits to ensure that new sources of particulates and precursors are well-controlled. However, the NRDC has found that state and local governments will likely await promulgation of new NAAQS before acting.

The NRDC report recommended the need to complete the following research:

- Improvements in emissions monitoring and inventories, and speciation of fine particle mass at ambient monitors so control strategies can target fine particle emissions,
- Additional studies of emissions components like ammonia and carbonaceous aerosols,
- Better atmospheric chemistry studies to build improved models, and
- Research in control technologies for fine particles and problematic components, like secondary organic aerosols.